



LIVER BIOCHEMISTRY

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Received 19th Apr 2022,
Accepted 17th May 2022,
Online 11th Jun 2022

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ABSTRACT: *The liver plays many important functions in the metabolic processes involving the dietary aspect in health and disease. Regular intake of bioactive compounds is associated with beneficial effects on chronic diseases, including liver diseases. The aim of this chapter is to provide a comprehensive overview of the effect of nutritional interventions on liver biomarkers in animal models, with emphasis on the participation of functional foods and intestinal microbiota. An update of some cytohistological and molecular biology techniques used to detect biochemical, inflammatory biomarkers are also presented.*

KEYWORDS: *biological chemistry, scientific work, inflammatory biomarkers, liver, health, disease, etc.*

INTRODUCTION

It is believed that the first understanding of biological chemistry began with the experiments of the famous French scientist A. Lavoisier (1743-1794) in the late eighteenth century. His classical research on oxidation and the role of oxygen in this process led to the discovery of the chemical basis of the phenomenon of "burning" in the body. Lavoisier concluded that this reaction absorbs oxygen, releases carbon dioxide, and generates heat. Based on the scientific work of A. Lavoisier in the study of energy metabolism of the body, it was determined how much energy is released when burning one gram of fat, protein and carbohydrates. Scientific advances in the field of biochemistry in the twentieth century have led to revolutionary changes in this area. Fundamental research in the field of enzymology, proteins, lipids, carbohydrates, as well as the study of the structure and function of the genome has raised biological chemistry to a higher level of biological science. In the development of this science on proteins and amino

acids A.Danilevsky, SSSalazkin, L.Poling and V.Kori; on vitamins K.Funk and N.I.Lunin; A. Bach, V. Palladin on tissue respiration; phosphorylation associated with oxidation, in which the role of ATF V. Engelgard; F. Misher, A. Belozersky, A. Spirin on the structure and function of nucleic acids, protein biosynthesis; Scientists in the field of bioenergy, such as V.Skulachyev, have made a significant contribution to the development of biochemistry around the world. His natural desire to find the cause of human diseases and to find drugs against them has aroused interest in the processes that take place in living organisms.

The liver is the most important internal organ that acts as a filter, purifying the blood from toxic substances, toxins and other toxins. It is the largest gland in the human body and is directly involved in the metabolism of protein, fat and carbohydrates. Responds to detoxification, blood, digestion and excretion. Without this organ, the human body would not function. Therefore, it is necessary to prevent pollution of nature, to prevent damage to the organism due to the negative effects of the environment. Pollution of the environment by anthropogenic factors is one of the most pressing issues today. This, in turn, has a serious impact on the human body. Today, increasing pollution is a major factor in the development of various diseases around the world. If we look at the example of Uzbekistan alone, we can see that up to 40% of the atmosphere is made up of toxic gases, smoke produced by car engines. These fumes in themselves have a negative effect on the body's respiratory system and other organs. As a result, we can observe the emergence of various diseases. Inflammation of the lungs, respiratory diseases, inflammation of the liver cells. The organ that fights such toxins is the liver. The liver is derived from the word "heper" and acts as a digestive gland in the body. Participates in the digestion and absorption of food in humans and animals, stores fat and carbohydrates. In chordates, animals and humans, the liver is an important organ for complex life, and the liver is larger than that of fish, amphibians, reptiles, birds, and mammals. The shape of the liver also depends on the body structure of the animal. The liver is the largest gland in the body (1200–2200). The color is reddish-brown, with the large right part different from the smaller left part. The liver is made up of many individual cells called hepatocytes. Between the hepatocytes are the bile ducts, which are the beginning of the bile ducts. Hepatocytes are large polygonal cells (20–25 µm). The liver is made up of 60% of the cellular elements and performs most of the major functions of the organ. Each such cell is a small "chemical laboratory" that neutralizes all harmful substances and toxins that enter the body. Special stellate cells of the liver are capable of producing phagocytes and antibodies. The liver can store blood and is involved in the production of blood elements and hemoglobin during embryonic development. One-fifth of the blood in the body can fit into the blood vessels of the liver.

Biochemistry is taking a new place in pharmaceutical practice. In particular, enzymes, which are biological catalysts, are used in industry to synthesize drugs (for example, steroid hormones). Prospective ways to produce natural medicines using genetic engineering are being considered. Knowledge of the biochemistry of microorganisms has allowed the development of convenient and cost-effective methods for the industrial production of drugs such as amino acids, nucleotides, nucleosides, vitamins, antibiotics. Methods for rapid and specific analysis of drugs using enzymes as analytical reagents have been developed. Management of liver metabolism. The liver is one of the central organs involved in metabolism. In the gastrointestinal tract, the liver receives digested substances through the portal vein and transfers them to the general circulation. The main biochemical processes of the organism in which the liver is involved are:

1. Carbohydrate metabolism.
2. Metabolism of proteins and urea synthesis, which is its end product.
3. Metabolism of fats, synthesis of bile acids, which are a necessary factor in their digestion, the formation of bile.
4. Synthesis of substances necessary for other organs; synthesis of glucose, ketone bodies and blood plasma proteins.
5. Neutralization of toxins formed in the body metabolism and entering the body from the external environment.
6. Excretion in the intestine of certain substances formed as a result of metabolism (cholesterol, bile acids, bile pigments and other substances).
7. In the management of blood circulation; connecting the portal venous system with the general circulatory system.
8. Blood-forming central organ (in embryos).
9. Control of blood clotting with the production of fibrinogen, prothrombin and heparin.
10. Conversion of provitamins into vitamins.
11. Iron carrier - involved in the synthesis of transferrin, ferritins and other functions.

The liver is involved in the metabolism of nutrients - carbohydrates, lipids, proteins, vitamins and, in part, water-minerals. Regulation of carbohydrate metabolism - the liver is the only organ that maintains a constant level of glucose in the blood, even during starvation. In the liver, glucose processed during glycogenolysis and gluconeogenesis is transferred to the blood and primarily used for nerve tissue activity. Excess glucose enters the liver and accumulates in the form of glycogen. Regulation of lipid metabolism is associated with the biosynthesis in the liver of various lipids (cholesterol, triacylglycerol,

phosphoglyceride, sphingomyelin, etc.), which are distributed through the blood to other tissues. The liver synthesizes more cholesterol than it receives with food: on average, the human body consumes 0.3-0.5 g of cholesterol per day with food, while the liver synthesizes 2-4 g of cholesterol per day. The distribution of lipids in organs and tissues is carried out by the liver. In addition, the breakdown of fatty acids in the liver produces ketone bodies, which are used as an energy source in organs other than the liver. The ability of the liver to neutralize xenobiotics is insufficient in newborns. For example, the activity of conjugated glucuronyltransferase, acetylating and deacetylating enzymes in one-month-old children is four to five times lower than in adults. For this reason, the metabolism of toxins and drugs in children is extremely slow. Therefore, the amount of medication recommended for children is determined by their age.

Patients may develop progressive jaundice, worsening of their liver biochemistry, or symptoms of cholangitis, prompting investigation for a dominant stricture. A dominant stricture is defined as a stricture less than 1.5 mm diameter in the CBD, or less than 1 mm in the left or right main hepatic ducts. Approximately 10–20% of patients with PSC develop a dominant stricture at some stage. If symptomatic, dominant strictures should be dilated with endoscopic balloon dilatation via ERCP and often require multiple dilatations over time, occasionally requiring temporary stent insertion. Dominant strictures may be benign, or represent CCA, the latter being notoriously difficult to diagnose. Antibiotics should be administered in the setting of acute cholangitis related to a dominant stricture, and prophylactic antibiotics, such as low-dose ciprofloxacin, are sometimes required in the setting of recurrent cholangitis. The progression from simple steatosis (generally considered benign) to steatohepatitis (necroinflammatory change and hepatocellular injury) has been suggested to follow a “two-hit” model.³⁷ The first hit results from any interference in the metabolism of free fatty acids, leading to free fatty acid accumulation in the liver. The second hit may be due to oxidative stress resulting from metabolism of excess fatty acids or could result from proinflammatory cytokines. Thus, the insulin resistance and subclinical inflammation present in obesity contribute to the development of NAFLD. Weight loss and improved insulin sensitivity appear to reduce hepatic steatosis,^{38,39} although additional study is needed to fully understand the effects of various therapeutic interventions.

Laboratory tests in cases of pyogenic liver abscesses reveal leukocytosis in many cases. Liver biochemistries are also abnormal in most of the patients; however, normal results do not exclude the diagnosis. Serum alkaline phosphatase level is elevated in two-thirds of patients and tends to be more markedly elevated than transaminase levels. Blood cultures are positive in about half of the patients. Multiple samples should be obtained, because this may be the only clue to the pathogenic agent prior to starting antimicrobial therapy. Leukocytosis is moderate in cases of amebic liver abscesses, and

eosinophilia is rare. Anemia is a typical finding. Overall, the incidence of liver test abnormalities is the same in patients with amebic liver abscess or with pyogenic liver abscess. Most patients (>70%) with amebic abscess do not have detectable parasites in the stool, therefore serologic testing for antibodies to *E. histolytica* is the most useful diagnostic test. The most commonly used serologic test currently is the enzyme immunoassay (EIA), because it is rapid, stable, and more specific and sensitive than other diagnostic tests. The liver is the central biochemical laboratory of the body, in which various metabolic transformations of substances take place. It is also included in all metabolic processes occurring in peripheral tissues. The chemical composition of the liver: water - 70%, proteins - 12-24, lipids - 2-6, carbohydrates - 2-8, cholesterol - 0.3-0.5, iron - 0.02% and other minerals. In an adult healthy person, the weight of the liver is on average 1-1.5 kg. Cellular composition of the liver:

- 1) hepatocytes - 80%, located in two layers and in contact with bile on one side, and with blood on the other;
- 2) endothelial cells - 15%;
- 3) connective tissue cells - 5%.

The peculiarity of the blood supply to the liver is that mixed blood (venous-arterial) circulates in it through the sinusoids (dilated capillaries). 70-80% of the total blood volume enters it through the portal vein (venous blood) from the intestine, and along with this blood, the breakdown products of proteins, lipids, polysaccharides and nucleic acids: glucose, amino acids, nitrogenous bases, chylomicrons, etc. 30% of the blood is delivered to the liver by the hepatic artery (arterial blood), and with it the metabolites of peripheral tissues and organs are delivered: alanine, lactate, glutamine, HDL (mature), glycerin, oxygen in the form of the potassium salt of oxyhemoglobin, etc. The hepatic vein takes out from liver into the general bloodstream glucose, amino acids, plasma proteins, enzymes, ketone bodies, VLDL, HDL precursors, urea and a number of other substances. The functions of the liver are numerous and complex, but the most important of them are biosynthetic, regulatory-homeostatic, hemostatic, urea-forming and bile-forming, excretory, catabolic, detoxifying.

Part of the metabolites formed in the liver (glucose, cholesterol, ketone bodies, plasma proteins, etc.) are transported further to the cells of other organs and tissues (i.e. "for export"), where they are used for energy and structural purposes, and part is deposited stored (e.g. glycogen, iron, fat soluble vitamins) or excreted from the body if not used. One of the functions of the liver is excretory. The liver secretes cholesterol, bile acids, bile pigments, iron, and other substances into the lumen of the gastrointestinal tract. In maintaining the constancy of the internal environment of the body (homeostatic function), the role of

the liver is unique, since it is the center of regulation of the main metabolic pathways: proteins, carbohydrates, lipids, nucleic acids and nucleotides, vitamins, water and electrolytes. Liver diseases and their biochemical changes. Infections and chemicals can damage liver cells and cause complete or partial dysfunction. In the violation of the integrity of the hepatocyte cortex, an increase in permeability is observed in the following changes. Increased activity and production of liver-specific enzymes in the blood. Normal AlAT (alanine aminotransferase), AsAT (aspartate aminotransferase) are almost not detected in the serum or are very low. The ratio of AsAT / AlaT enzymes is called de Ritis coefficient and is higher than 1 in a healthy person. This coefficient in liver disease

1. In addition, there is an increase in the activity of aldolase, LDG4 and LDG5, glutamate dehydrogenase, fructose-1-phosphataldolase in the serum.
2. Hyperbilirubinemia occurs directly due to bilirubin.
3. The amount of iron and vitamin B12 in the blood serum increases.

In cases of accumulation of bile or impaired excretory capacity of the liver:

- 1) Increased activity of g-glutamyltranspeptidase in the blood.
- 2) Increased activity of alkaline phosphatase in blood serum.
- 3) Hyperbilirubinemia is observed.
- 4) In hypercholesterolemia, the amount of ZPLP in the blood increases and the amount of ZYLP decreases.
- 5) When the excretory function of the liver is impaired, the substances secreted by the bile are retained in the internal environment of the body.

Biological chemistry has a lot in common with the chemical sciences, that is, physical chemistry. This is especially true for their methods of studying natural substances but biological chemistry and the chemical sciences face different tasks. Organic and physical chemistry, the structure of more chemical compounds and properties, such as their electronic structures, the nature of the bond and their mechanism of formation, isomerism, conformation, etc. For biological chemistry, the biological (functional) properties of all chemicals functions and physicochemical processes in a living organism, as well as a variety of understanding the mechanisms of disruption of these functions in diseases is a major task is biological chemistry is derived from a number of mixed disciplines as before, maintains an integral connection with them in the study of living nature, but at the same time it remains a peculiar and independent science of matter The relationship between the structure and their functions, chemical in a living organism exchange of compounds, the formation of energy in living systems pathways, physicochemical processes in the

organism, tissue, cell control mechanisms, genetic information in living organisms study of molecular mechanisms of transfer, etc.

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